2003 AG EXPO DOMESTIC WELL SCREENING BY THE MICHIGAN GROUNDWATER STEWARDSHIP PROGRAM AND THE MICHIGAN DEPARTMENT OF AGRICULTURE

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Thank you all, and see you next year!

EXECUTIVE SUMMARY

The Michigan Department of Agriculture (MDA) and the Michigan Groundwater Stewardship Program sponsored a domestic well water sample screening at the 2003 Michigan State University Agricultural Exposition (Ag Expo). The screening was held from July 22 - 24. MDA laboratory staff screened 1,821 samples for atrazine, nitrate, and nitrite. Samples were submitted with a short questionnaire about well characteristics and land use.

Samples were tested for the presence of the triazine herbicide atrazine using ELISA (enzyme-linked immunosorbent assay) methods. The ELISA kits used also react in varying degrees to other triazines, including simazine and prometon, and some triazine breakdown products.

Samples were tested for nitrate and nitrite using a simple strip test. Test strips were dipped in samples, and color development on the strip was compared to standards and color charts to estimate nitrate and nitrite concentrations.

Results showed 23 wells tested positive for atrazine or other triazines, at a detection level of 0.1 μg/l (micrograms per liter, equivalent to parts-per-billion, or ppb). Of those wells, 20 had levels between 0.1 and 0.6 μg/l, and 3 had levels between 0.6 and 1.4 μg/l. The Maximum Contaminant Level (MCL) for atrazine in drinking water is 3 μg/l. Ten wells from Monroe County tested positive for atrazine. Atrazine is widely used in the county, and many domestic wells in the county are shallow and completed in karst bedrock overlain by thin glacial deposits, making them vulnerable to contamination.

Only 2 wells tested positive for nitrite, or NO_2-N, at a detection of 0.15 mg/L (milligrams/liter, equivalent to parts-per-million or ppm). The highest level detected was 1 mg/L nitrite-N, a level above the nitrite MCL. This well also had a high nitrate level (20 mg/L NO_3-N), and was fairly close to a septic system and an animal feeding or holding area.

Nitrate results are summarized in the table below. The nitrate MCL is 10 mg/L nitrate-N.

Table 1. Nitrate results for the Ag Expo 2003 MDA domestic well screening (Executive Summary).

Ag Expo 2003 Well Screening Results for Nitrate						
	Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
	≤1	≥2 and<5	≥5 and<10	≥10 and ≤20	>20	**Total Samples**
Total and Percent of Total by Nitrate-N Level	1083 59.5 %	412 22.6%	229 12.6%	92 5.1%	5 0.3%	1821 100%

Several statistically significant relationships were found between nitrate levels, well characteristics, and land use. The test used was the Kruskal-Wallis nonparametric test. Shallower wells were significantly more likely to have higher nitrate levels ($p<0.001$). Older wells were also significantly more likely to have higher nitrate levels ($p=0.035$). Wells closer to farm fields were significantly more likely to have higher nitrate levels ($p<0.001$). There was also a significant relationship between the distance to an animal yard (feedlot, penned horse, cows, chickens, pigs) and nitrate levels. Wells closer to animal yards tended to have higher nitrate levels ($p<0.010$).

There was no significant relationship between the distance from a well to the nearest septic system, or the distance from a well to a chemical storage or mixing area.

Of 1,789 participants who answered the question "Are there pregnant women or infants under the age of 6 months in your home?" on the questionnaire, 57 answered "Yes". There was no significant difference between the nitrate levels of participants with pregnant women or infants served by a domestic well and those of participants with no infants and/or pregnant women served by the well. There were 2 wells with a nitrate level above the 10 ppm nitrate-N MCL that served a household with an infant of 6 months or younger and/or a pregnant woman. This does not mean, however, that they consume the well water. Another 30 wells serving an infant under 6 months of age and/or a pregnant woman showed nitrate-N levels below the nitrate MCL but above background levels, indicating human-related nitrate sources had affected the water supply.

Estimated direct costs (supplies, shipping, printing, postage) for the sample screening were approximately $15,000; and Lansing-based staff spent approximately 60 FTE days on the event, including sample handling, analysis, data entry, and reporting. The time expended by all the participating groundwater stewardship programs and local partners is probably equal at least to the Lansing program.

It is important to emphasize that these data are *not* representative of the domestic well population of Michigan. In a situation such as the Ag Expo well screening, with self-selecting participants, one would normally expect to receive relatively more samples from well owners concerned about their water quality. Because water quality concerns are frequently justified, this means that detection frequencies and/or levels of detections can reasonably be expected to be higher at an event such as Ag Expo.

The Ag Expo 2003 results show that triazine contamination is not widespread among participants. The immunoassay method is an effective way to screen large numbers of samples relatively cheaply. The MDA groundwater monitoring program will consider using immunoassay technology to screen for other contaminants as the opportunity and need arise.

Groundwater quality problems may be the result of land use practices from decades past, and may bear no relationship to current management practices. They may also be the result of practices at some distance from the point of observed impact. Nitrate in particular, because of its widespread presence, solubility, and consequent mobility, may serve to indicate that there is a water quality problem, but it is a tricky and unreliable guide to the exact source of the problem.

Agricultural producers are the primary source of nitrogen applied to much of the landscape. Efforts to limit or mitigate nitrate contamination in Michigan groundwater will be ineffectual unless producers are involved and engaged in the efforts. Many, of course, already are. There are numerous programs designed to help agricultural producers minimize nutrient losses. No one program will work for all producers. To the best of our ability as policy makers, technical experts, and service providers, we must make sure that we match producers with the stewardship programs most likely to meet both individual and social goals.

INTRODUCTION

Ag Expo

The Michigan State University Agricultural Exposition (MSU Ag Expo) is Michigan's largest farm show. It is held for three days each summer in a 35-acre exhibit area on the MSU campus. Ag Expo organizers state that more than 90 percent of Michigan field crop income, livestock income, and net farm income is produced within a two-hour drive of the event. There are more than 250 commercial and educational exhibits, and daily demonstrations on different farming activities. The agricultural focus, the publicity, and the central location make it an ideal setting for holding a domestic well water screening event.

The Michigan Department of Agriculture (MDA) Groundwater Monitoring Program and the Michigan Groundwater Stewardship Program (MGSP) have sponsored free domestic well water sample screenings at Ag Expo since 1995. These events are open to any domestic well owner or user in Michigan. MDA staff screen the domestic well water samples for nitrate, nitrite, and atrazine. This report describes the FY 2003 Ag Expo water sample screening, including summaries and analyses of the results. The screening was held from July 22 - 24.

MDA Groundwater Monitoring Program

The MDA Groundwater Monitoring Program samples domestic wells throughout the state. The program also sponsors domestic well screening events around the state, including the Ag Expo sample screening, to which well owners can bring samples. The purpose of the groundwater monitoring program is to determine the nature and extent of pesticide and nitrogen fertilizer contamination in Michigan's groundwater, to reduce the potential for negative health impacts associated with the use of low-quality groundwater, and to use the information gathered to improve the way we communicate the risks to groundwater resources associated with different land-uses.

Michigan Groundwater Stewardship Program

The Michigan Groundwater Stewardship Program (MGSP) is a cooperative effort designed to reduce the risks of groundwater contamination associated with the use of pesticides and nitrogen fertilizers. The MGSP is voluntary, locally-driven, and designed to address the concerns of individuals by maintaining a focus on the financial and technical constraints that shape real-world decisions. The program is funded through fees assessed on sales of pesticides and nitrogen fertilizers

The MGSP is a cooperative effort between the Michigan Department of Agriculture, Michigan State University Extension, USDA Natural Resources Conservation Service, and Michigan's AmeriCorps. Close coordination is also maintained with Michigan Farm Bureau, Michigan Agri-Business Association, and the Michigan Association of Conservation Districts.

Drinking-Water Well Screenings

The MGSP and the MDA Groundwater Monitoring Program sponsor domestic well water screenings for several reasons. The screenings are a service to private well owners that they can use to evaluate their exposure to nitrate, nitrite, and atrazine. The screenings also serve an educational purpose. Well owners taking part in a sample screening learn about local and state groups working to protect groundwater, and they learn about potential sources of groundwater contamination. Participants have the opportunity to talk with water quality professionals about a variety of water quality issues, which they seem to appreciate. The well water screenings also have a promotional aspect. The free sample screenings attract some participants to groundwater stewardship events that they might not otherwise attend. Once at the event, MGSP staff have an opportunity to discuss the program and its benefits with participants.

The samples are screened for nitrate and nitrite using a simple colorimetric test strip. The test strip is dipped in the water sample for one second. Color development indicates nitrate and/or nitrite in the sample, and the intensity of the color is compared to a color chart to estimate the level of nitrate or nitrite in the sample. The strips are inexpensive and accurate.

Water samples are screened for atrazine using enzyme-linked immunosorbent assay (ELISA, or immunoassay) kits. The kits used are designed using atrazine as the target analyte, but will also react with a number of other triazines to varying degrees, due to the cross-reactivity inherent in many immunochemical reactions.

Water screening results are confidential, and are mailed to well owners. Once all results have been successfully reported to well owners, identifying information is stripped from the results.

METHODS

Promotion and Publicity

Both the state and local groundwater stewardship programs handled promotion and publicity for the Ag Expo sample screening. For publicity, programs relied primarily on word-of-mouth and on community calendar and public service announcements in local newspapers and radio spots. The MDA public information official wrote a press release for the event that was distributed to all programs. At least some of the local programs used the MDA press release as part of their promotion. Some of the local programs also wrote their own press releases and public service announcements. Flyers describing the screening were distributed to all local programs, and to many MSU Extension offices as well.

Sample bottles (125 ml) with sampling instructions were distributed to individuals through local groundwater stewardship programs and associated conservation district and MSU county extension offices. The bottles and instructions were paid for by the state groundwater monitoring program. Approximately 2,500 sets of bottles and instructions were distributed throughout the state.

Review of ELISA Technology

ELISA methods are based on a reaction between a target analyte and an antibody. A sensitive antibody will detect very small levels of an analyte in a sample. A specific antibody will bind primarily or exclusively to the target analyte, and ignore similar compounds. Specificity is measured in terms of cross-reactivity, or the degree to which the antibody will bind to a substance other than its target. Cross-reactivity may be a problem if testing for an analyte in a matrix (soil, wine, milk, etc) that may hold similar compounds. Cross-reactivity may be desirable, however, when screening for a number of related compounds, such as a family of pesticides.

Immunoassay kits, including ELISA kits, are manufactured using antibodies created to bind to the analyte of interest. Antibody production is stimulated when a pesticide (attached to a carrier molecule large enough to be "noticed" by the immune system) is injected into an animal. Once antibodies specific to the pesticide have been generated, a carrier molecule is no longer needed. The antibodies will recognize and bind to the pesticide itself.

ELISA tests rely on competition for a limited number of antibody binding sites between the target analyte (e.g., pesticide) in a sample and a labeled form of the same analyte used as part of the analysis. In the case of atrazine, the labeled analyte is an atrazine-enzyme conjugate added to the sample. The atrazine portion of the conjugate binds to the antibody, while the enzyme portion reacts with coloring compounds. The atrazine-enzyme compound competes with atrazine and other reactive triazines in the sample to bind to the limited number of antibody sites. The more atrazine in the sample, the fewer atrazine-enzyme conjugate molecules can bind to the antibodies and coloring agents. This means that the color of the sample is inversely proportional to the level of reactive triazines in the sample. The lighter the color, the higher the level of triazines in the sample. Using atrazine standards and a spectrometer to measure the absorbance of a given wavelength of light, a calibration curve can be created and the level of triazines in samples can be determined.

ELISA methods have been used extensively in the last ten to fifteen years to screen and analyze large numbers of samples for pesticides and other analytes of interest. Immunoassay methods can be used for water, soil, milk, wine, food, and other samples. In some cases, an extract or wash must be performed first. Personal Exposure Monitors and related sampling devices and methods can be used to gauge personal exposure, pesticide spray drift, or dermal exposure during pesticide handling operations.

Immunoassays have several advantages over laboratory-based methods. In general, studies have shown ELISA methods to be simpler, faster, less expensive, and more portable than methods such as gas chromatography/mass spectrometry (GC/MS). Immunoassays often allow rapid characterization of contaminated sites in the field, enabling faster site remediation and cleanup. ELISA methods can also be used in many cases by personnel untrained in analytical chemistry procedures.

The incidence of false positives tends to be higher for ELISA methods. A false positive is a detection of an analyte by a method that cannot be confirmed by the reference method. The reference method for ELISA analyses is GC/MS or another laboratory-based method, such as liquid chromatography/mass spectrometry (LC/MS).

Sample Collection and Submission

The MDA Ag Expo sample screening flyer, containing sampling instructions, is shown in the Appendix. All samples were collected by well owners or their agents. Approximately 80 percent of the samples were then delivered to local groundwater stewardship program offices, or to affiliated offices. MGSP staff or cooperating partners then delivered the samples directly to the MDA Lab. The remaining 20 percent of the samples were submitted in person at a tent set up in the event area.

Most samples were submitted in the sample bottles distributed by the groundwater monitoring program. A wide variety of containers was used to submit the rest of the samples, including canning jars, re-used food jars and containers, water and soft drink bottles, and others.

Samples were assigned a sample number and logged by MDA staff at the Expo tent and the MDA lab. Samples were submitted with a short survey describing the well sampled, land use near the well, and whether or not the well supplies water for use by infants or pregnant women. The survey is shown in the Appendix.

Sample Analysis

After samples were logged, an aliquot of 1 ml was taken from each sample and placed in a labeled auto-sampler vial. The bulk of the sample was used for the nitrate-nitrite screening. Samples were analyzed for triazines at the MDA Lab using standard ELISA methods. See the Appendix for details of the specific method. The range of quantitation for the EnviroGard™ 72110 triazine plate kit is 0.1 to 2 ppb. The instructions indicate that orbital mixing at 200 rpm during the 1 hour incubation period is recommended, but not necessary. Due to the large number of samples analyzed, orbital mixing was not used.

The ELISA samples were analyzed on a Hyperion MicroReader 3™ strip reader using a dual wavelength (450 nm/650 nm) method. Triazine concentrations were calculated using the strip reader's on-board software. The algorithm used is a regression of the logit of the sample absorbance by the log of standard atrazine concentrations. The sample absorbance logit calculation is shown below.

Where sample absorbance $= B$, and the Negative Control absorbance $= B_C$,

$$Logit\ B = Ln\left(\frac{B/B_C}{1-(B/B_C)}\right)$$

Samples were screened for nitrate and nitrite using *Hach AquaChek™ Water Quality Test Strips*. The strips have an approximate detection limit of 1 mg/L nitrate-as-nitrogen and 0.15 mg/L nitrite-as-nitrogen. Each test strip had two detector pads–one for nitrite and the other for nitrate. Test strips were dipped in the samples for approximately one second. The strips were then kept level for 30 seconds, when the nitrite concentration was estimated from any developed color. The nitrate concentration was estimated at 60 seconds. Nitrate standards were used to give staff an example of the corresponding color on the test strip.

RESULTS

MDA staff analyzed 1821 samples during Ag Expo 2003. At least one sample was received from 59 of the 68 counties in the Lower Peninsula. No samples were received from the Upper Peninsula. Of the nine counties in the Lower Peninsula from which no Ag Expo samples were received, one had previously participated in another MDA domestic well screening in 2003. State-wide Ag Expo results are summarized in the three tables below.

Nitrate

Nitrate-Nitrogen (NO3–N, nitrate-N) is a naturally occurring form of nitrogen that is also manufactured for different uses, such as fertilizer. Most nitrates in groundwater are created from the breakdown of organic matter, such as animal manure, septic system waste, and plant materials; and from industrial and agricultural chemicals (Mueller and Helsel, 1996; Koelliker et. al, 1992). Nitrates dissolve easily in water and are easily carried into the water table.

Table 2. Nitrate results for the Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Nitrate						
	Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
	≤1	≥2 and<5	≥5 and<10	≥10 and ≤20	>20	**Total Samples**
Total and Percent of Total by Nitrate-N Level	1083 59.5 %	412 22.6%	229 12.6%	92 5.1%	5 0.3%	1821 100%

The nitrate screening showed that approximately 5.4 percent of the samples submitted were at or above the public drinking water standard Maximum Contaminant Level (MCL) of 10 milligrams per liter of nitrate-N, equivalent to 10 parts-per-million (ppm) nitrate-N. An MCL is a national regulatory standard enforced for all public water supplies. Public water supplies must keep concentrations of any contaminants in the water below MCLs. Wells used only for private domestic water supply generally do not have to meet MCLs, though some jurisdictions may require proof of potable water before property can be bought or sold.

Another 35.1 percent of the samples showed levels of nitrate indicating human impact on the water sampled. Human impact is indicated by nitrate-N levels above 2 ppm (Mueller and Helsel, 1996).

The remaining 59.5 percent of the samples did not show signs of elevated nitrate levels. For purposes of statistical analysis, discussed below, all samples at or above the nitrate MCL were combined into one category, creating four nitrate categories for the analyses.

Nitrite

Nitrite-Nitrogen (NO2–N, nitrite-N) is a naturally occurring form of nitrogen that is also manufactured for different uses. Nitrites are used in small amounts to preserve meat, such as cold cuts, bacon, and hot dogs. Nitrites dissolve easily in water, and can quickly be carried down to the water table. High levels of nitrite-N in well water (above 1 part per million) can be a sign of microbiological contamination from animal or human waste (such as manure or septic system waste) and should be investigated.

Table 3. Nitrite results for the Ag Expo 2003 MDA domestic well screening

Ag Expo 2003 Well Screening Results for Nitrite				
	Nitrite-N Levels in ppm (parts-per-million, equivalent to mg/L)			
	<0.2	≤ 0.2 and <1	≥ 1	**Total Samples**
Total and Percent of Total by Nitrite-N Level	1819 99.9%	1 0.05%	1 0.05%	1821 100%

Only two samples tested positive for nitrite in the 2003 sample screening. One sample tested positive for nitrite-N at or above 1 ppm, the public drinking water supply Maximum Contaminant Level for nitrite. One other sample tested positive for nitrite at a level indicating human impact on the water source, but below the nitrite MCL. The remaining 99.9 percent of samples did not have a detectable level of nitrite, at a detection level of 0.15 ppm nitrite-N.

Triazines

"Triazine" is a term used to refer to a group of chemically-related herbicides. There are no naturally occurring triazines, so any detection of triazines in groundwater is a sign of human impact. Atrazine is the most heavily used triazine in Michigan and the U. S., and the triazine most often detected in surface and groundwater. Atrazine is a federal Restricted Use Pesticide (RUP), meaning that anywhere in the nation it is intended for use only by certified pesticide applicators. Some other commonly used triazines, including simazine and prometon, are not federal RUPs, though some states may restrict their use in particular areas or circumstances.

Table 4. Triazine results for Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Atrazine				
	Atrazine Levels in ppb (parts-per-billion, equivalent to µg/L)			
	Not Detected	≥ 0.1 and <0.6	≥ 0.6 and ≤ 1.4	**Total Samples**
Total and Percent of Total by Atrazine Level	1798 98.7%	20 1.1%	3 0.2%	1821 100%

Twenty-three samples tested positive for triazines at the 2003 Ag Expo sample screening. Of these samples, three were clearly *not* from domestic supply wells. One sample was identified as coming from a pond well, one from a barn well, and one from an irrigation well. Interestingly, these three samples all had relatively low levels of triazines detected, that is, below 0.15 parts-per-billion (ppb). Nine of the samples appear to have come from domestic supply wells. No source of the samples was identified for the remaining eleven samples. Of the three samples with triazine concentrations above 0.6 ppb, one was collected from a domestic well. This well had the highest level detected during the screening, at 1.4 ppb. The well owner indicated atrazine had been used on the property. The sources of the other two samples were not identified. All the triazine detections were below the public drinking water standard Maximum Contaminant Level for atrazine of 3 µg/l. Sample screening results are broken out by county and groundwater stewardship program in Tables 4 through 8.

Results for Subgroups

Answers to the questionnaire that participants submitted with their samples were analyzed for relationships between nitrate levels, as determined by the screening results, and well characteristics, land use, and the well users. Nitrate results were grouped into four different categories, from background levels or lower (Category 1) to results above the MCL (Category 4). The categories are equivalent to the results shown in Table 1, except that all results above the MCL were combined into one category. SPSS 11.0.1 statistical software was used for the analyses. The low number of nitrite and triazine detections does not allow the use of the statistical methods available to demonstrate relationships between relevant variables.

A number of the analyses are illustrated below using boxplots. Boxplots are summary plots based on the median, quartiles, and extreme values of the data. Descriptions of the different elements of a boxplot are shown in Figure 1 (Helsel and Hirsch, 1993, pp 24-26,451-453; Norušis, 1998, pp 100-101).

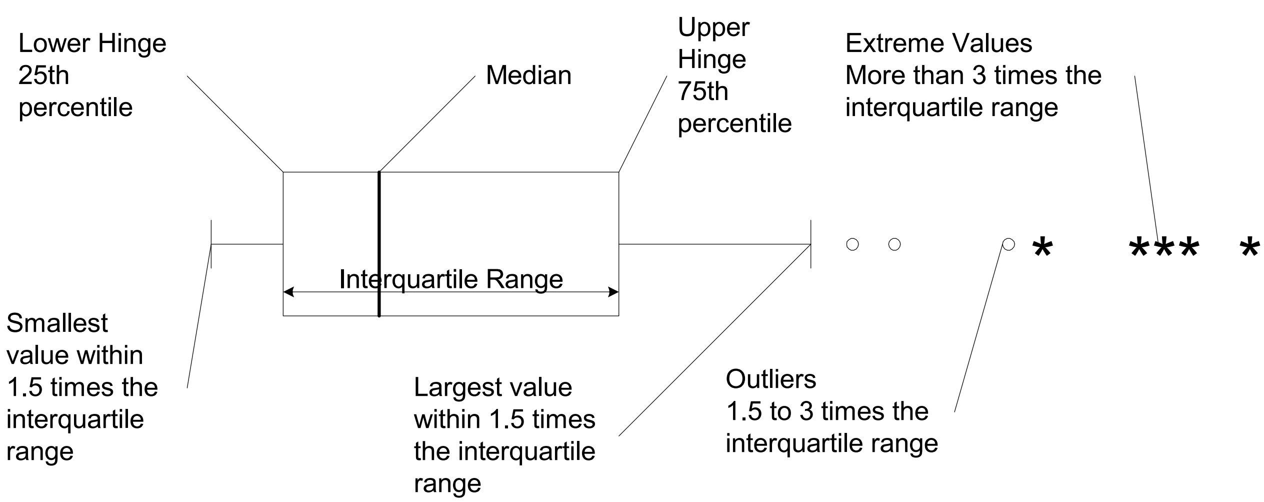


Figure 1. Diagram of boxplot (or box and whisker plot).

Of 1,789 participants who answered the question “Are there pregnant women or infants under the age of 6 months in your home” on the one-page questionnaire, 57 answered “Yes”. Using estimates based on the Michigan Vital Statistics for 2001, this number is *not* significantly different than would be expected if households with pregnant women or infants under the age of 6 months were proportionally represented in the Ag Expo well screening. In the 2001 Ag Expo screening, the number of samples from households with an infant under 6 months of age or with a pregnant woman was significantly higher than would be expected if they were represented in proportion to their frequency in the general population.

There was no significant difference between the nitrate levels of participants with pregnant women or infants served by the domestic well sampled and those of participants with no infants and/or pregnant women using the well sampled for Ag Expo. There were 2 wells with a nitrate screening level above the 10 ppm nitrate-N MCL that served an infant 6 months old or younger and/or a pregnant woman. This does not mean, however, that they consume the well water. Another 30 wells serving an infant under 6 months of age and/or a pregnant woman showed nitrate-N levels below the nitrate MCL but above background levels, indicating human-related nitrate sources had affected the water supply.

There were several significant relationships observed from the Ag Expo 2003 data. There was a significant inverse relationship for Ag Expo 2003 samples between well depth and the nitrate level of samples. The shallowest wells were the most likely to fall into the highest nitrate category. The statistical test used was the Kruskal-Wallis nonparametric rank test. All well depths were ranked, with shallow wells having lower ranks (shallowest well=1). If there were no relationship between well depth and nitrate categories, the average rank for the well depths would be approximately equal for all four nitrate categories. However, the wells with the highest nitrate levels had a significantly lower mean rank for well depths (*$p < 0.001$).*

There was a similar relationship observed between well age and the categorized nitrate level of samples using the Kruskal-Wallis test. Wells with higher nitrate levels had a significantly higher mean rank for well age (*$p=0.035$*); meaning older wells were more likely to fall into the higher nitrate categories.

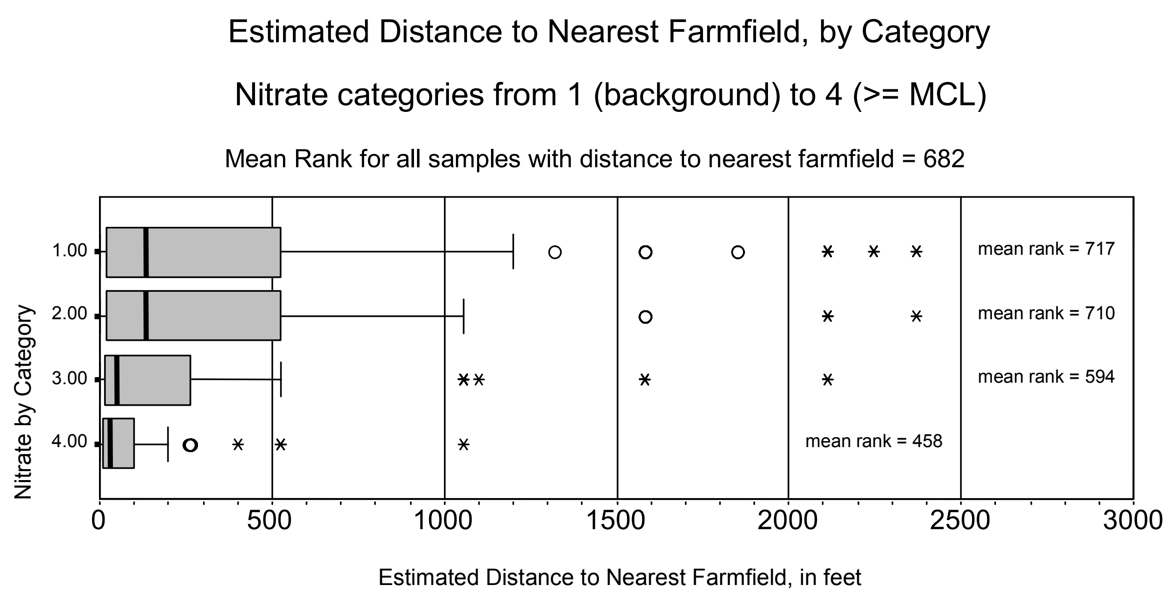
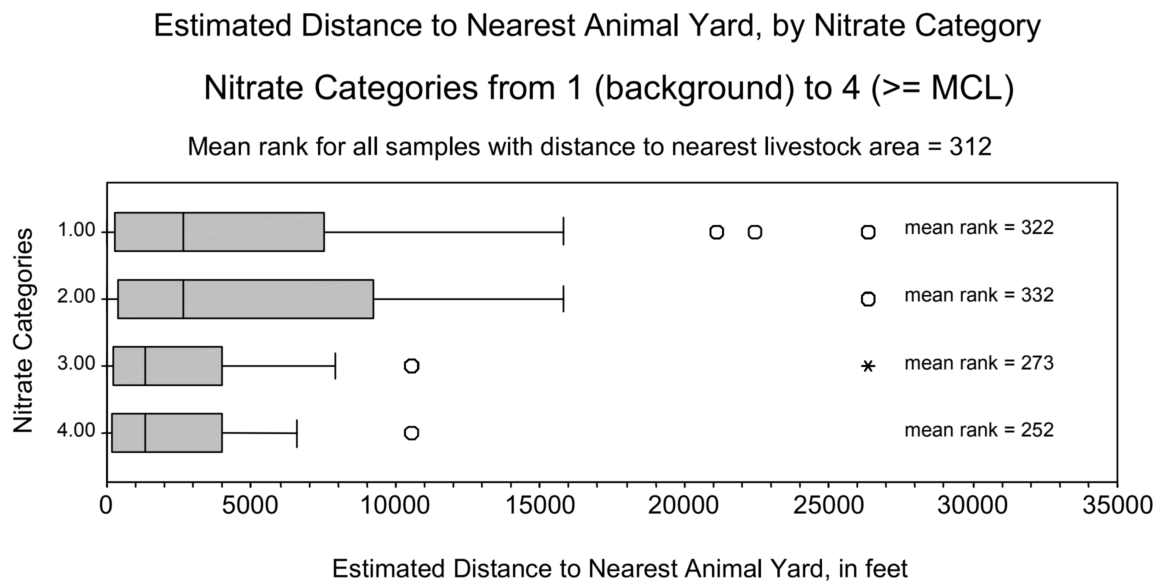


Figure 2. Estimated distance and mean rank of distance to nearest farm field, by nitrate category, for Ag Expo 2003 MDA domestic well screening.

There was also a significant inverse relationship observed between the nitrate category of a sample and the distance to the nearest farm field. The statistical test used in this analysis was also the nonparametric Kruskal-Wallis rank test. The samples collected from wells farther away from the nearest farm field (higher rank) clustered in the lower nitrate categories; the samples from wells closer to the nearest farm filed clustered in the higher nitrate categories ($p < 0.001$). Figure 2 shows the distribution of the distance to the nearest farm field for samples by the category of the nitrate results.

Participants were also asked to give the distance from their well to an animal yard (feedlot, penned horse, cows, chickens, pigs). There were 624 participants that answered the question. There was a significant inverse relationship *(a=0.01)* between the distance



from the well to an animal yard and the nitrate category of the corresponding sample (Kruskal-Wallis test, $p = 0.010$). Figure 3 illustrates this relationship. Wells that were closer to animal yards tended to fall into the higher nitrate categories.

Figure 3. Boxplots of the distribution of the estimated distance to the nearest animal yard, by nitrate result category, for Ag Expo 2003 MDA domestic well screening.

Several statistical tests were applied to the relationship between the distance to the nearest septic system and nitrate levels, but no relationship was observed (Kruskal-Wallis test, p=*0.243*). Figure 4 shows the distribution of the distance to the nearest septic field data for each category.

No significant relationship was found for the Ag Expo 2003 samples between nitrate levels and the distance to the nearest chemical mixing area using the Kruskal-Wallis test ($p=0.140$). However, there is ample evidence from other studies showing the risk to wells associated with chemical mixing areas.

In the one-page questionnaire that was turned in with samples, participants were asked if any triazines had been applied to their property within the last three years. Of the 1,717 participants, 1,070 answered "No", 534 did not know ("Unknown"), 113 answered "Yes", and 104 did not answer. Due to the low number of atrazine detections at Ag Expo 2003, it is difficult to make any meaningful statements about relationships between atrazine detections and other factors based only on this data.

Estimated Distance to Nearest Septic Field, by Nitrate Category

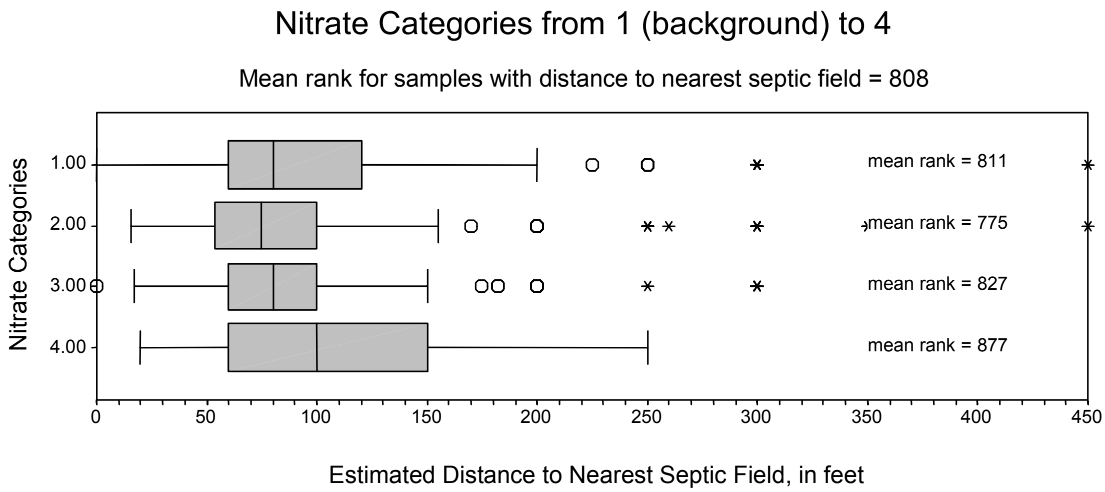


Figure 4. Boxplots of distributions of distance to nearest septic field by nitrate result category, for Ag Expo 2003 MDA domestic well screening.

Ten of the triazine detections were from samples collected in Monroe County. The combination of atrazine use and the karst geology of much of the county leads to a relatively high proportion of domestic wells contaminated by atrazine.

DISCUSSION

The first point that needs to be emphasized is that these data are *not* representative of the domestic well population of Michigan. In a situation such as the Ag Expo well screening, with self-selecting participants, one would normally expect to receive relatively more samples from well owners concerned about their water quality. Because water quality concerns are frequently justified, this means that detection frequencies and/or levels of detections can reasonably be expected to be higher at an event such as Ag Expo.

Comparing results from Ag Expo 2003 to those from the MDA domestic well baseline study (Pigg, 2000) indicates this is the case. For the Ag Expo screening, 5.4 percent of the nitrate samples were estimated to be above the drinking water MCL of 10 ppm nitrate-N. In the baseline study it was estimated that *at most* 1.9 percent of rural well owners had nitrate-N levels of 10 ppm or higher. Using a similar maximum likelihood estimate for the Ag Expo screening, it could be estimated that *at most* 6.5 percent of Ag Expo samples would be over 10 ppm nitrate-N in future events.

Nitrate levels between 2 and 9.9 ppm nitrate-N indicate human-related nitrate sources have probably affected groundwater quality. The baseline study estimated 9.3 % (±4.3%) of rural Michigan domestic wells have nitrate levels in this range. For Ag Expo 2003, 35.2% of the samples had results in this range.

Ag Expo 2003 showed 59% of nitrate samples contained *less than* 2 ppm nitrate-N, a range indicating no observable nitrate impact on groundwater quality (Mueller and Helsel, 1996). The baseline study estimates that 90.5% (±4.3%) of rural Michigan domestic wells show no sign of human nitrate impact.

It's not possible to compare pesticide results from the baseline study to the triazine results from Ag Expo. The analytical methods and the compounds detected are too different.

Nitrite detection frequencies for the two studies are similar— 0.5% for the baseline study (using the same detection limit as the Ag Expo study) and 0.1% for the Ag Expo screening. This suggests that nitrite problems may not be associated with factors that concern Ag Expo participants.

The Ag Expo results agree with data from other studies that show an inverse relationship between well depth and nitrate contamination, and between nitrate levels and distance to nitrate sources. For Ag Expo the distance to a farm field or to an animal yard served as a proxy as a distance to a nitrate source. The fact that nitrate levels were not significantly related to the distance from septic fields indicates that the nitrate sources of concern for the Ag Expo population are related to agricultural applications and to animal sources.

The non-parametric statistical methods used are quite robust, and are the most appropriate for data such as the Ag Expo results. While participants can not be expected to know exactly how close they are to the nearest farm field, they do know if they are relatively close to or far from one. Rank sum tests eliminate much of the bias introduced by extremely inaccurate estimates of factors such as well depth and distance to farm fields.

Costs

The estimated direct costs for the Ag Expo screening are shown below. The costs and time estimates apply to the MDA and Groundwater Stewardship Team Lansing staff. The time expended by all the participating groundwater stewardship programs and local partners is probably equal at least to the Lansing program.

Triazine Kits and Nitrate Test strips	$12,200
Bottles	$850
Shipping and postage	$1,000
Printing and copies	$500
Total	**$14,550**

Sample Handling and Analysis	32	FTE days
Data Entry	16	FTE days
Event Preparation and Reporting Results	12	FTE days
Total	**60**	**FTE days**
FTE day represents a “full-time equivalent day”, or eight hours of work.		

There are a number of benefits from the Ag Expo screening. The screening can provide well owners with valuable peace of mind, or serve to warn the participants of possible water quality problems. This information is of particular interest and utility for the 57 households in the 2003 well screening with wells serving an infant or a pregnant woman. The screening serves as a way to inform people of the groundwater stewardship program and its many services. As shown in this report, it can serve as a data source for relationships between water quality, household characteristics, and land use. It can also indicate the location of potential groundwater contamination hot spots.

CONCLUSIONS AND RECOMMENDATIONS

Ag Expo appears to draw participants with poorer water quality than most Michigan domestic users, as shown by the higher relative frequency of nitrate contamination in the Ag Expo results as compared to the baseline domestic well study. As such, we may be able to learn more about factors related to nitrate contamination from such a group.

The results of the FY 2003 Ag Expo well screening show clearly that Michigan is not immune to the problems of nitrate contamination in domestic wells. These data showed significant inverse relationships between nitrate levels in wells and the distance to a farm or to an animal yard. Farm fields are regularly fertilized with nitrogen fertilizers, manure, or both. The three most common sources of nitrate in domestic wells are nitrogen fertilizer, manure, and septic systems (Koelliker and others, 1992). The data from Ag Expo showed no relationship between the distance to septic systems and nitrate levels in wells. This indicates that for Ag Expo participants, the nitrate sources of concern are nitrogen fertilizer and manure.

The study also showed clearly that shallower and older wells are more likely to have higher nitrate levels than deeper wells. This agrees with results from a variety of studies, and provides additional evidence that Michigan does not enjoy a unique exception to relationships observed elsewhere.

Ag Expo results show that triazine contamination is not widespread among participants. The immunoassay method is an effective way to screen large numbers of samples relatively cheaply. The MDA groundwater monitoring program will consider using immunoassay technology to screen for other contaminants as the opportunity and need arise.

Groundwater quality problems may be the result of land use practices from decades past, and may bear no relationship to current management practices. They may also be the result of practices at some distance from the point of observed impact. Nitrate in particular, because of its widespread presence, solubility, and consequent mobility, may serve to indicate that there is a water quality problem, but it is a tricky and unreliable guide to the exact source of the problem.

Agricultural producers are the primary source of nitrogen applied to much of the landscape. Efforts to limit or mitigate nitrate contamination in Michigan groundwater will be ineffectual unless producers are involved and engaged in the efforts. Many, of course, already are. There are numerous programs designed to help agricultural producers minimize nutrient losses. No one program will work for all producers. To the best of our ability as policy makers, technical experts, and service providers, we must make sure that we match producers with the stewardship programs most likely to meet both individual and social goals.

Table 5. Atrazine screening results by county, for Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Atrazine by County				
	Atrazine Levels in ppb (parts-per-billion, equivalent to µg/L)			
	Not Detected	≥ 0.1 and < 0.6	≥ 0.6 and ≤ 1.4	County Total
Alcona	8			8
Alpena	31			31
Antrim	37			37
Arenac	2			2
Barry	18			18
Bay	3			3
Benzie	56			56
Branch	3			3
Calhoun	3			3
Cass	17		1	18
Charlevoix	10			10
Cheboygan	3			3
Clinton	6			6
Crawford	3			3
Eaton	8			8
Emmet	47			47
Genesee	13	1		14
Gladwin	6			6
Grand Traverse	317			317
Gratiot	4			4
Huron	72			72
Ingham	9			9
Ionia	7			7
Iosco	41			41
Jackson	17			17
Kalamazoo	55	3		58
Kalkaska	38			38
Lake	25			25
Lapeer	1			1
Leelanau	216	1		217
Lenawee	3			3
Livingston	2			2
Macomb	6			6
Manistee	167			167
Mason	129	2		131
Midland	1			1
Missaukee	51			51
Monroe	35	10		45
Montcalm	1			1
Montmorency	1			1
Muskegon	4			4

Ag Expo 2003 Well Screening Results for Atrazine by County				
	Atrazine Levels in ppb (parts-per-billion, equivalent to μg/L)			
	Not Detected	**≥ 0.1 and < 0.6**	**≥ 0.6 and ≤ 1.4**	**County Total**
Oakland	1			1
Oceana	98	2	1	101
Ogemaw	18			18
Osceola	7			7
Oscoda	13			13
Otsego	77			77
Presque Isle	1			1
Roscommon	1			1
Saginaw	2		1	3
St. Clair	6			6
St. Joseph	22			22
Sanilac	9			9
Shiawassee	24			24
Tuscola	6			6
Van Buren	8			8
Washtenaw	12			12
Wayne	3	1		4
Wexford	13			13
Elkhart, IN	1			1
Grand Total	1798	20	3	1821

Table 6. Nitrate results by county, for Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Nitrate by County						
	Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
	≤ 1	≥ 2 and <5	≥ 5 and <10	≥ 10 and ≤ 20	>20	County Total
Alcona	8					8
Alpena	20	4	5	2		31
Antrim	26	6	3	1	1	37
Arenac	2					2
Barry	14	2	2			18
Bay	3					3
Benzie	41	12	3			56
Branch			1	2		3
Calhoun	3					3
Cass	4	4	6	4		18
Charlevoix	8	2				10
Cheboygan	3					3
Clinton	5	1				6
Crawford	2	1				3
Eaton	8					8
Emmet	36	8	3			47
Genesee	14					14
Gladwin	6					6
Grand Traverse	186	55	54	21	1	317
Gratiot	4					4
Huron	67	2	3			72
Ingham	9					9
Ionia	4	1	1	1		7
Iosco	31	7	1	2		41
Jackson	16				1	17
Kalamazoo	24	13	14	7		58
Kalkaska	23	14		1		38
Lake	21	3	1			25
Lapeer	1					1
Leelanau	124	47	33	13		217
Lenawee	1	1		1		3
Livingston	2					2
Macomb	6					6
Manistee	66	71	27	3		167
Mason	56	41	24	10		131
Midland	1					1
Missaukee	18	20	11	1	1	51
Monroe	27	13	3	2		45
Montcalm	1					1
Montmorency	1					1

Ag Expo 2003 Well Screening Results for Nitrate by County						
	Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
	≤ 1	**≥ 2 and <5**	**≥ 5 and <10**	**≥ 10 and ≤ 20**	**>20**	**County Total**
Muskegon	2	1	1			4
Oakland	1					1
Oceana	36	40	16	9		101
Ogemaw	14	1	2	1		18
Osceola	3	2	2			7
Oscoda	11	1	1			13
Otsego	46	27	3	1		77
Presque Isle	1					1
Roscommon	1					1
Saginaw	3					3
St. Clair	6					6
St. Joseph	10	1	4	6	1	22
Sanilac	9					9
Shiawassee	23		1			24
Tuscola	4	1		1		6
Van Buren	1	5	1	1		8
Washtenaw	11			1		12
Wayne	2		2			4
Wexford	6	5	1	1		13
Elkhart, IN	1					1
Grand Total	1083	412	229	92	5	1821

Table 7. Nitrite results by county, for the Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Nitrite by County				
	Nitrite-N Levels in ppm (parts-per-million, equivalent to mg/L)			
	<0.2	≥ 0.2 and <1	≥ 1	County Total
Alcona	8			8
Alpena	31			31
Antrim	37			37
Arenac	2			2
Barry	18			18
Bay	3			3
Benzie	56			56
Branch	3			3
Calhoun	3			3
Cass	18			18
Charlevoix	10			10
Cheboygan	3			3
Clinton	6			6
Crawford	3			3
Eaton	8			8
Emmet	47			47
Genesee	14			14
Gladwin	6			6
Grand Traverse	317			317
Gratiot	4			4
Huron	72			72
Ingham	9			9
Ionia	7			7
Iosco	41			41
Jackson	17			17
Kalamazoo	58			58
Kalkaska	38			38
Lake	25			25
Lapeer	1			1
Leelanau	216	1		217
Lenawee	3			3
Livingston	2			2
Macomb	6			6
Manistee	167			167
Mason	131			131
Midland	1			1
Missaukee	51			51
Monroe	45			45
Montcalm	1			1
Montmorency	1			1
Muskegon	4			4

Ag Expo 2003 Well Screening Results for Nitrite by County				
	Nitrite-N Levels in ppm (parts-per-million, equivalent to mg/L)			
	<0.2	≥ 0.2 and <1	≥ 1	County Total
Oakland	1			1
Oceana	100		1	101
Ogemaw	18			18
Osceola	7			7
Oscoda	13			13
Otsego	77			77
Presque Isle	1			1
Roscommon	1			1
Saginaw	3			3
Sanilac	9			9
Shiawassee	24			24
St. Clair	6			6
St. Joseph	22			22
Tuscola	6			6
Van Buren	8			8
Washtenaw	12			12
Wayne	4			4
Wexford	13			13
Elkhart	1			1
Grand Total	1819	1	1	1821

Table 8. Atrazine results by groundwater stewardship program, for the Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Atrazine by Groundwater Stewardship Program					
		Atrazine Levels in ppb (parts-per-billion, equivalent to µg/L)			
		Not Detected	≥ 0.1 and < 0.6	≥ 0.6 and < 3	Grand Total
Program	**County**				
1	Alcona	8			8
	Alpena	31			31
	Cheboygan	3			3
	Montmorency	1			1
	Presque Isle	1			1
1 Total		**44**			**44**
2	Barry	18			18
	Eaton	8			8
2 Total		**26**			**26**
3	Arenac	2			2
	Bay	3			3
	Midland	1			1
	Saginaw	2		1	3
	Sanilac	9			9
3 Total		**17**		**1**	**18**
5	Branch	3			3
	Calhoun	3			3
5 Total		**6**			**6**
6	Cass	17		1	18
6 Total		**17**		**1**	**18**
8	Benzie	56			56
	Grand Traverse	317			317
	Kalkaska	38			38
	Leelanau	216	1		217
8 Total		**627**	**1**		**628**
9	Clinton	6			6
	Gratiot	4			4
9 Total		**10**			**10**
11	Huron	72			72
11 Total		**72**			**72**
12	Ingham	9			9
	Livingston	2			2
12 Total		**11**			**11**
13	Ionia	7			7
13 Total		**7**			**7**
14	Gladwin	6			6
14 Total		**6**			**6**

Ag Expo 2003 Well Screening Results for Atrazine by Groundwater Stewardship Program					
		Atrazine Levels in ppb (parts-per-billion, equivalent to µg/L)			
		Not Detected	≥ 0.1 and < 0.6	≥ 0.6 and < 3	Grand Total
15	Jackson	17			17
15 Total		**17**			**17**
16	Lapeer	1			1
16 Total		**1**			**1**
17	Lenawee	3			3
	Monroe	35	10		45
17 Total		**38**	**10**		**48**
18	Manistee	167			167
	Mason	129	2		131
	Oceana	98	2	1	101
18 Total		**394**	**4**	**1**	**399**
19	Montcalm	1			1
19 Total		**1**			**1**
20	Missaukee	51			51
	Wexford	13			13
20 Total		**64**			**64**
21	Muskegon	4			4
21 Total		**4**			**4**
22	Osceola	7			7
22 Total		**7**			**7**
25	Genesee	13	1		14
	Shiawassee	24			24
	St. Clair	6			6
	St. Joseph	22			22
25 Total		**65**	**1**		**66**
26	Kalamazoo	55	3		58
26 Total		**55**	**3**		**58**
27	Tuscola	6			6
27 Total		**6**			**6**
28	Van Buren	8			8
28 Total		**8**			**8**
98	Lake	25			25
98 Total		**25**			**25**
99	Antrim	37			37
	Charlevoix	10			10
	Crawford	3			3
	Elkhart	1			1
	Emmet	47			47
	Iosco	41			41
	Macomb	6			6
	Oakland	1			1

Ag Expo 2003 Well Screening Results for Atrazine by Groundwater Stewardship Program					
		Atrazine Levels in ppb (parts-per-billion, equivalent to µg/L)			
		Not Detected	≥ 0.1 and < 0.6	≥ 0.6 and < 3	Grand Total
	Ogemaw	18			18
	Oscoda	13			13
	Otsego	77			77
	Roscommon	1			1
	Washtenaw	12			12
	Wayne	3	1		4
99 Total		**270**	**1**		**271**
Grand Total		**1798**	**20**	**3**	**1821**

Table 9. Nitrate results by groundwater stewardship program, for the Ag Expo 2003 MDA domestic well screening.

Ag Expo 2003 Well Screening Results for Nitrate by Groundwater Stewardship Program							
		Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
		≤ 1	**≥ 2 and < 5**	**≥ 5 and <10**	**≥ 10 and ≤ 20**	**> 20**	**Grand Total**
Program	**County**						
1	Alcona	8					8
	Alpena	20	4	5			31
	Cheboygan	3					3
	Montmorency	1					1
	Presque Isle	1					1
1 Total		**33**	**4**	**5**			**44**
2	Barry	14	2	2			18
	Eaton	8					8
2 Total		**22**	**2**	**2**			**26**
3	Arenac	2					2
	Bay	3					3
	Midland	1					1
	Saginaw	3					3
	Sanilac	9					9
3 Total		**18**					**18**
5	Branch			1			3
	Calhoun	3					3
5 Total		**3**		**1**			**6**
6	Cass	4	4	6			18
6 Total		**4**	**4**	**6**			**18**
8	Benzie	41	12	3			56
	Grand Traverse	186	55	54		1	317
	Kalkaska	23	14				38
	Leelanau	124	47	33			217
8 Total		**374**	**128**	**90**		**1**	**628**
9	Clinton	5	1				6
	Gratiot	4					4
9 Total		**9**	**1**				**10**
11	Huron	67	2	3			72
11 Total		**67**	**2**	**3**			**72**
12	Ingham	9					9
	Livingston	2					2
12 Total		**11**					**11**
13	Ionia	4	1	1			7
13 Total		**4**	**1**	**1**			**7**
14	Gladwin	6					6
14 Total		**6**					**6**

Ag Expo 2003 Well Screening Results for Nitrate by Groundwater Stewardship Program							
		Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
		≤ 1	≥ 2 and < 5	≥ 5 and <10	≥ 10 and ≤ 20	> 20	Grand Total
15	Jackson	16				1	17
	15 Total	**16**				**1**	**17**
16	Lapeer	1					1
	16 Total	**1**					**1**
17	Lenawee	1	1				3
	Monroe	27	13	3			45
	17 Total	**28**	**14**	**3**			**48**
18	Manistee	66	71	27			167
	Mason	56	41	24			131
	Oceana	36	40	16			101
	18 Total	**158**	**152**	**67**			**399**
19	Montcalm	1					1
	19 Total	**1**					**1**
20	Missaukee	18	20	11		1	51
	Wexford	6	5	1			13
	20 Total	**24**	**25**	**12**		**1**	**64**
21	Muskegon	2	1	1			4
	21 Total	**2**	**1**	**1**			**4**
22	Osceola	3	2	2			7
	22 Total	**3**	**2**	**2**			**7**
25	Genesee	14					14
	St. Clair	6					6
	St. Joseph	10	1	4		1	22
	Shiawassee	23		1			24
	25 Total	**53**	**1**	**5**		**1**	**66**
26	Kalamazoo	24	13	14			58
	26 Total	**24**	**13**	**14**			**58**
27	Tuscola	4	1				6
	27 Total	**4**	**1**				**6**
28	Van Buren	1	5	1			8
	28 Total	**1**	**5**	**1**			**8**
98	Lake	21	3	1			25
	98 Total	**21**	**3**	**1**			**25**
99	Antrim	26	6	3		1	37
	Charlevoix	8	2				10
	Crawford	2	1				3
	Emmet	36	8	3			47
	Iosco	31	7	1			41
	Macomb	6					6
	Oakland	1					1
	Ogemaw	14	1	2			18

Ag Expo 2003 Well Screening Results for Nitrate by Groundwater Stewardship Program							
		Nitrate-N Levels in ppm (parts-per-million, equivalent to mg/L)					
		≤ 1	≥ 2 and < 5	≥ 5 and <10	≥ 10 and ≤ 20	> 20	Grand Total
	Oscoda	11	1	1			13
	Otsego	46	27	3			77
	Roscommon	1					1
	Washtenaw	11					12
	Wayne	2		2			4
	Elkhart, IN	1					1
	99 Total	**196**	**53**	**15**		**1**	**271**
Grand Total		**1083**	**412**	**229**		**5**	**1821**

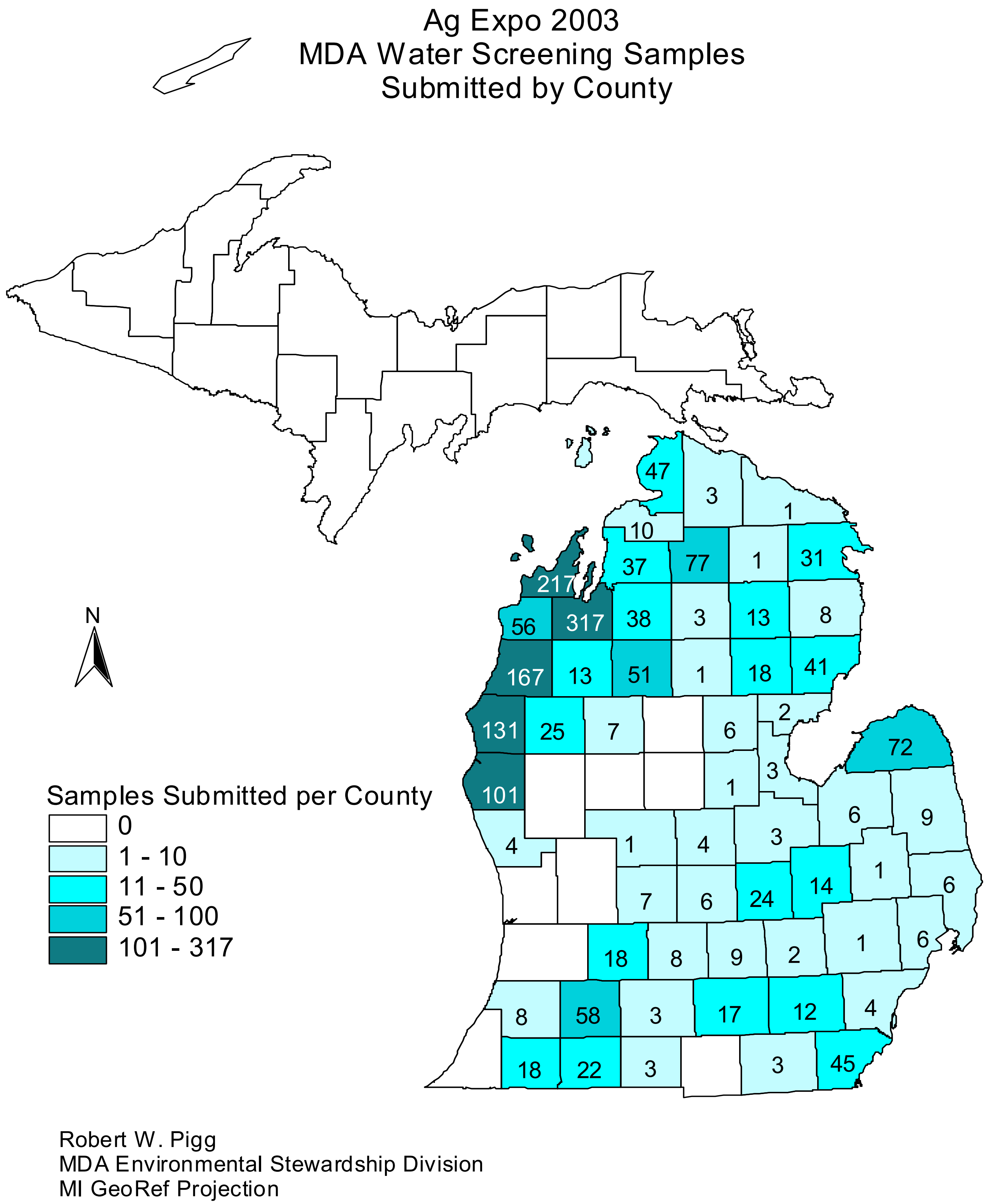


Figure 5. Color map of samples per county, for the Ag Expo 2003 MDA domestic well screening.

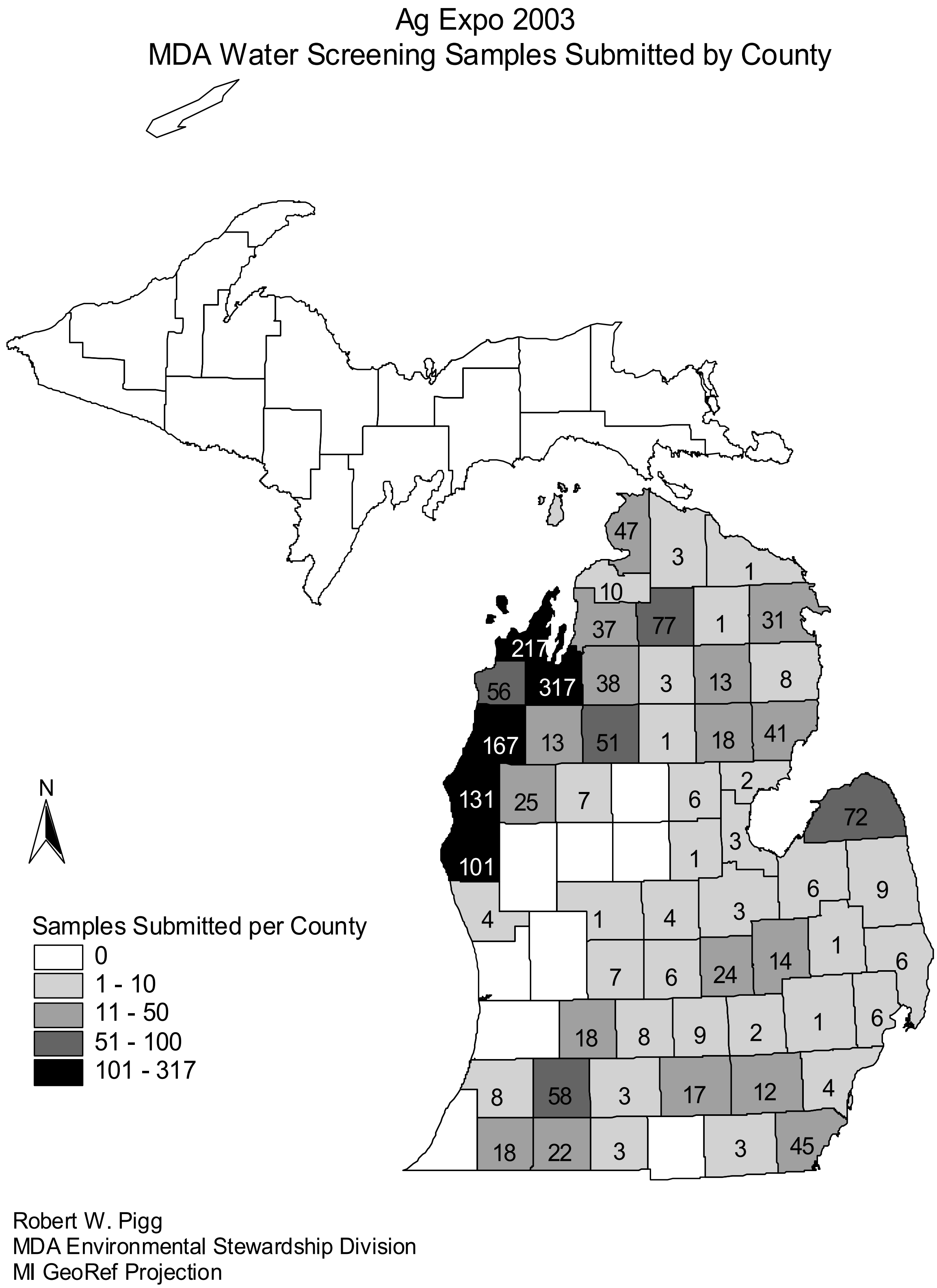


Figure 6. Grayscale map of samples per county for Ag Expo 2003 MDA domestic well screening.

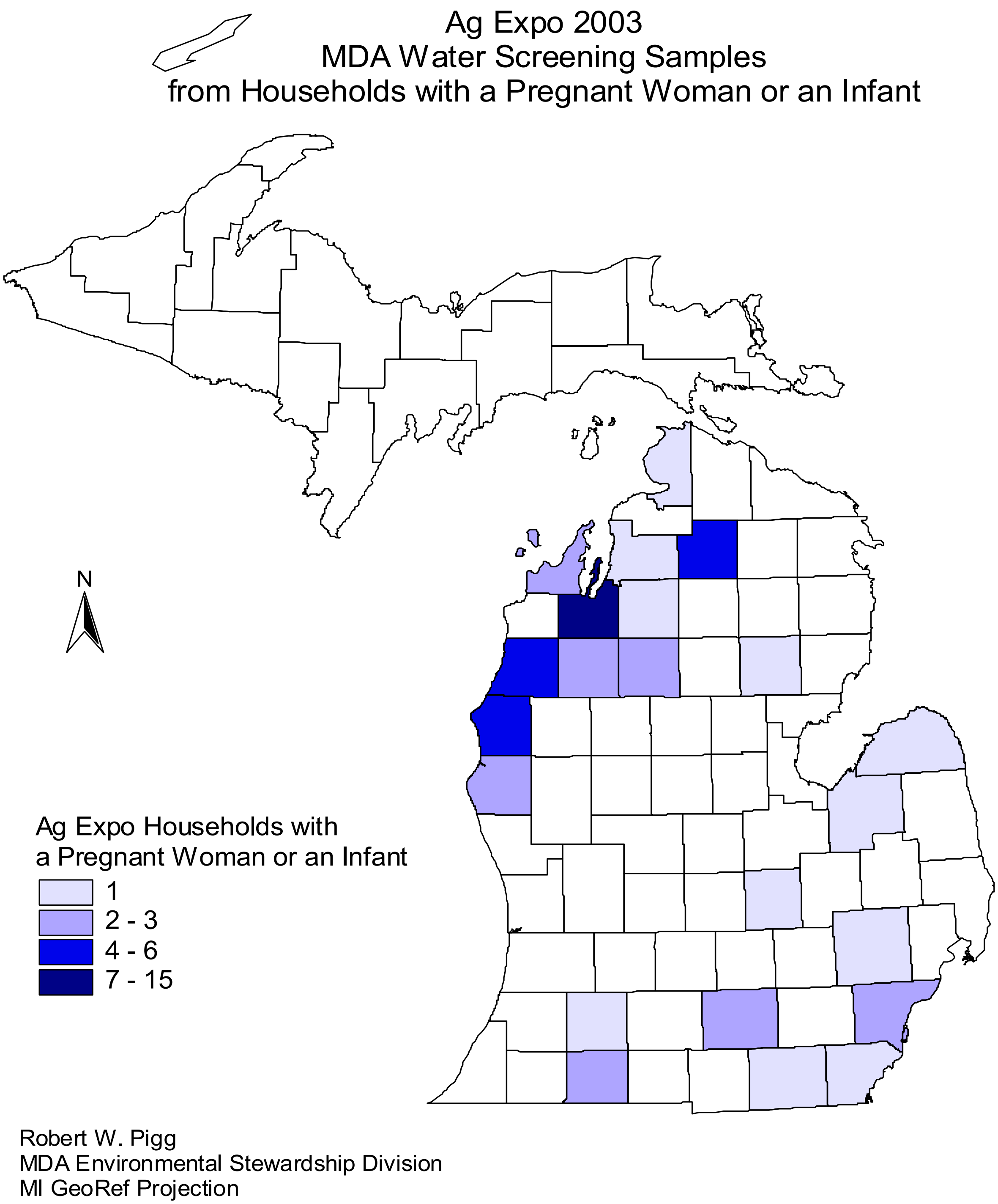


Figure 7. Color map showing the number of samples from households with an infant or a pregnant women at Ag Expo 2003 MDA domestic well screening.

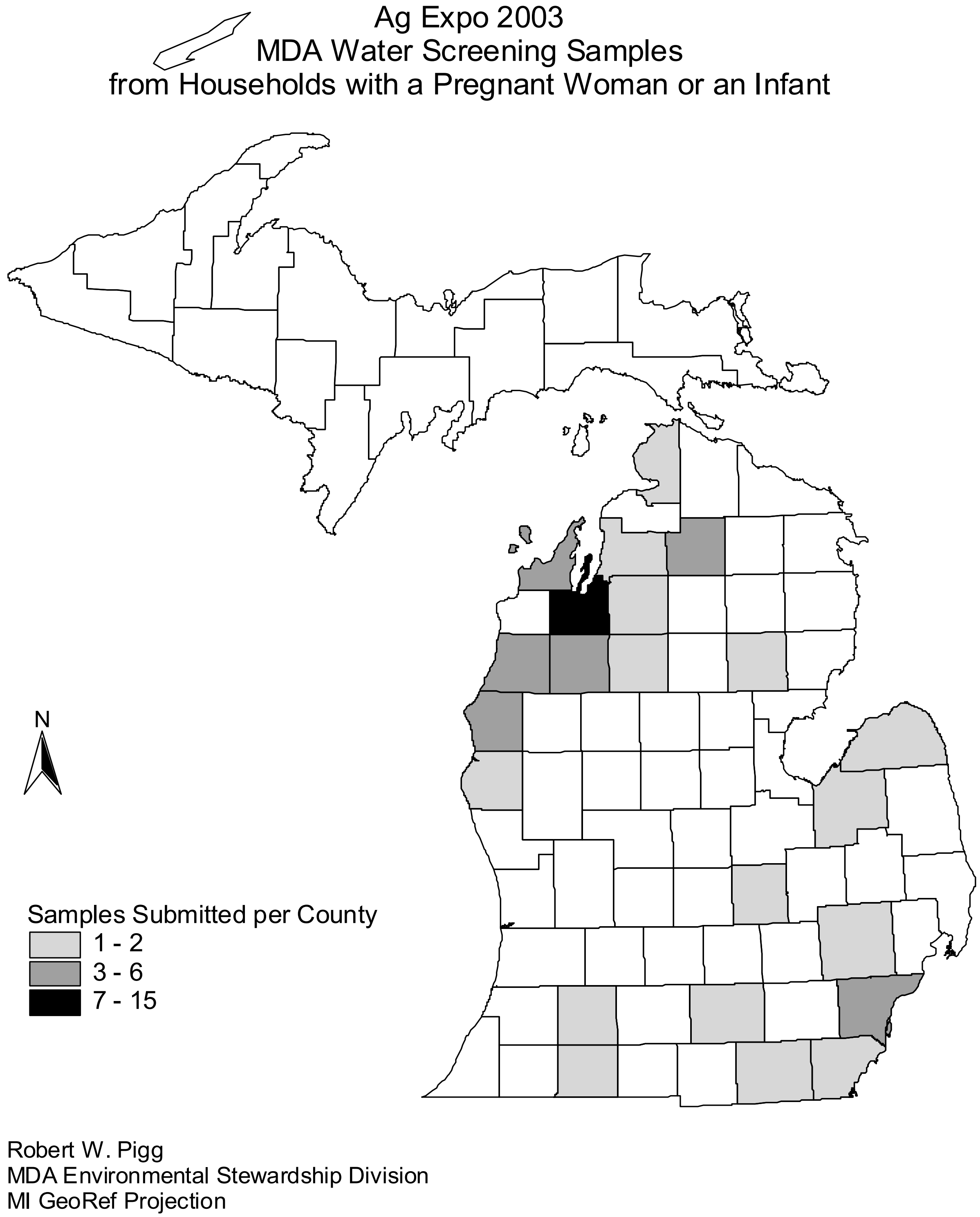


Figure 8. Grayscale map of the number of samples from households with an infant or pregnant woman at the Ag Expo 2003 MDA domestic well screening.

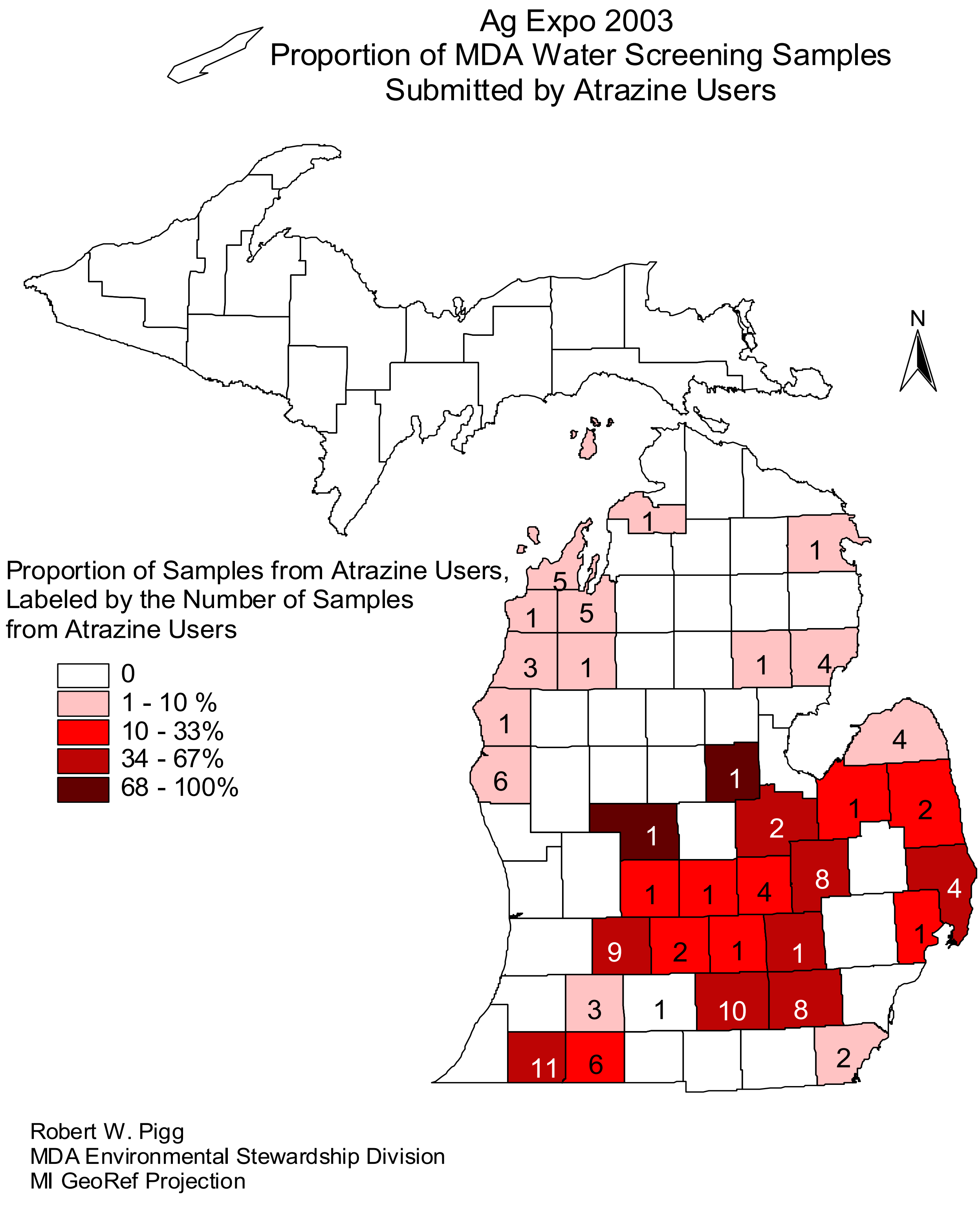


Figure 9. Color map of the proportion of samples from atrazine users by county, at the Ag Expo 2003 MDA domestic well screening.

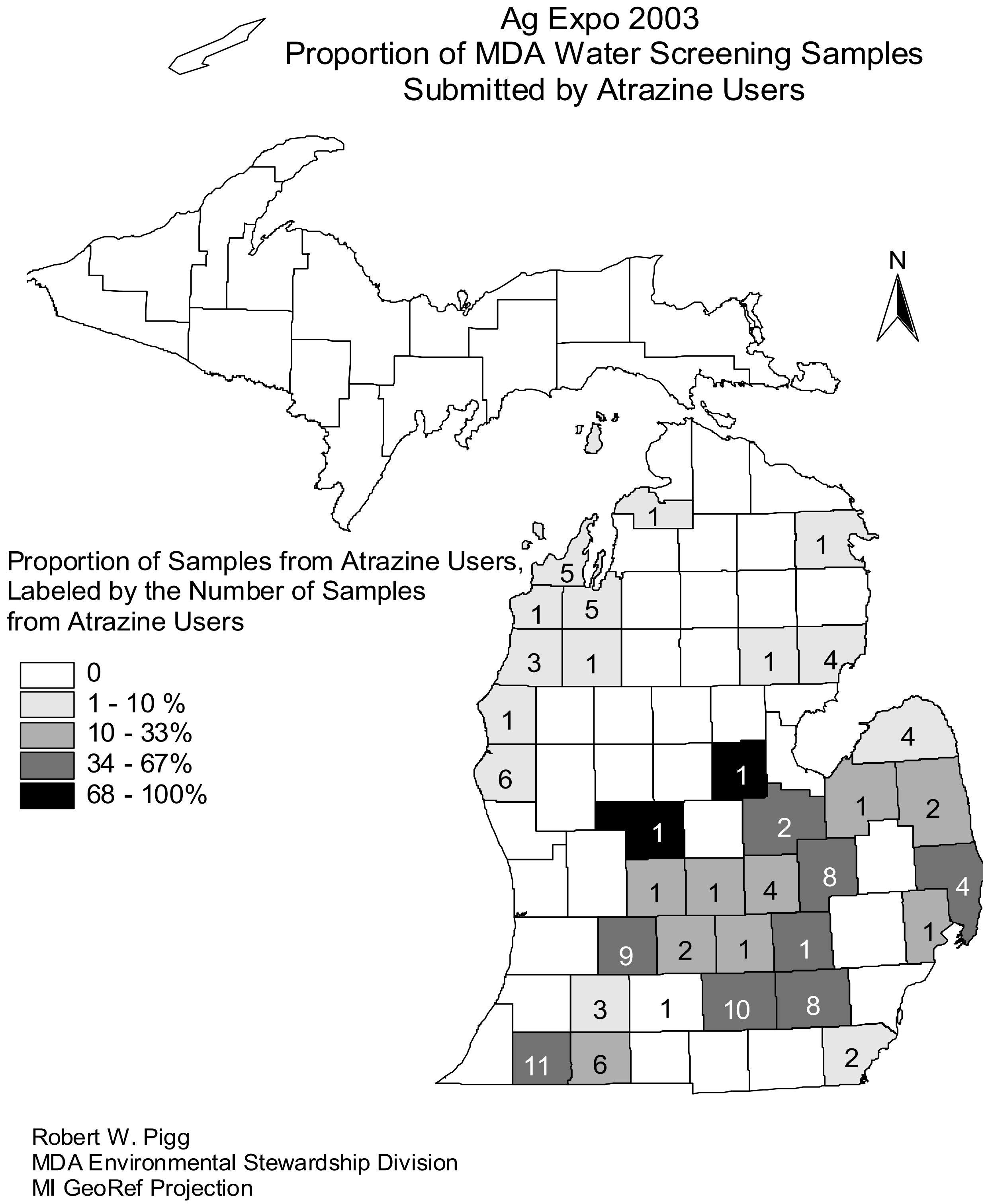
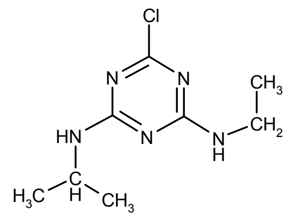
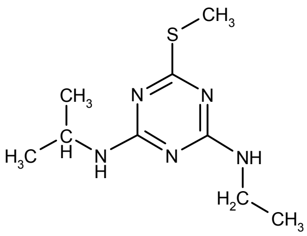


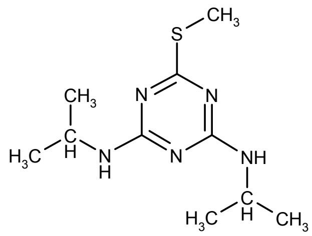
Figure 10. Grayscale map of the proportion of samples from atrazine users by county, at the Ag Expo 2003 MDA domestic well screening.



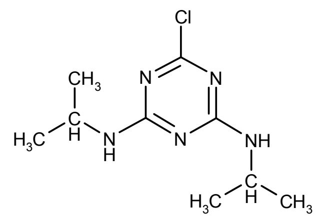
0.02; 0.25 μg/L
Atrazine



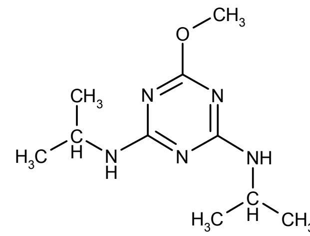
0.01; 0.16 μg/L
Ametryn



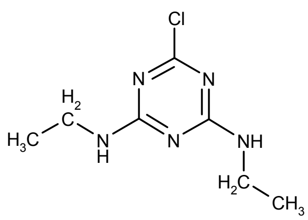
0.015; 0.27 μg/l
Prometryn



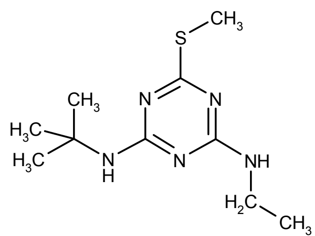
0.013; 0.2 μg/L
Propazine



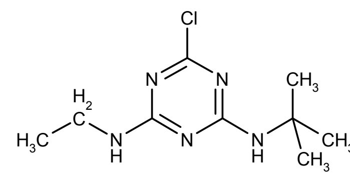
0.01; 0.3 μg/L
Prometon



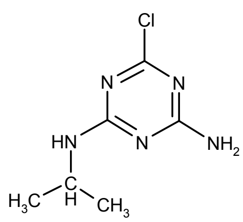
0.065; 1.5 μg/L
Simazine



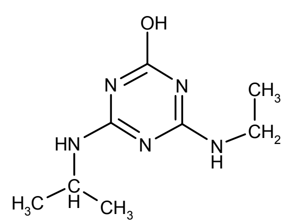
0.024; 3.1 μg/L
Terbutryn



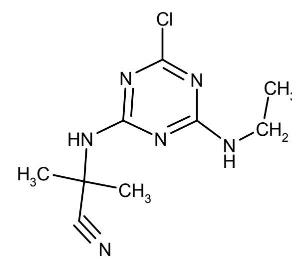
0.15; 2.5 μg/L
Terbuthylazine



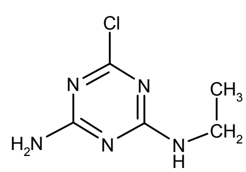
0.17; 12 μg/L
Deethylatrazine



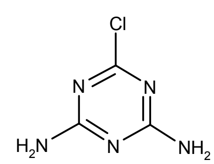
0.30; 23 μg/L
Hydroxyatrazine



1.34; 27 μg/L
Cyanazine



3.5; 62 μg/L
Deisopropylatrazine



Does not react
Didealkylatrazine

Figure 11. Chemical structures and cross-reactivity for triazines for the EnviroGard™ triazine Elisa plate kit. In units of μg/liter causing 10% and 50% cross-reactivity, respectively. After Thurman and others, 1990.

REFERENCES

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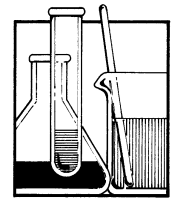
APPENDIX

Michigan Groundwater Stewardship Program
DRINKING WATER WELL TESTING PROGRAM
Tent 26
AG EXPO 2003
Michigan State University, East Lansing
July 22 – 24, 2003

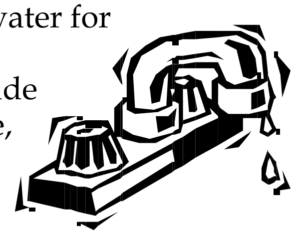


The Michigan Groundwater Stewardship Program (MGSP) and the Michigan Department of Agriculture (MDA) will screen drinking water well samples for free during Ag Expo 2003. Samples will be screened for nitrate and triazines (atrazine and some related herbicides). This year Ag Expo will be held from July 22–24 at Michigan State University in East Lansing. The water screening will be at Tent 26. Educational materials and information on groundwater stewardship will also be available. To have water from your well tested, follow the instructions provided below.

This service is for private drinking water wells only. Public water supplies are tested regularly. Please do **not** *bring in samples from public water supplies or non-drinking water samples.*

Testing for triazines and nitrate may be limited to the first 1,800 water samples. Sample bottles will be available on a limited basis from your local MGSP technician or your local MSU Extension office. You do *not* have to use a special bottle for this screening. Any small clean jar will work.

Collect the sample no more than 1 day before you will drop it off. First, fill out the sample information sheet. Next, pick a tap that is *not* connected to any water treatment devices (water softener, carbon filter, etc.). An outside faucet often works well. Then, run the water for 10 to 15 minutes, to flush the pipes and to make sure you are collecting a representative sample. Fill the bottle completely. Be careful not to touch the inside of the cap. Cap the sample, and label the bottle clearly with your name, the date, and the well name (cottage well, Mom's well, etc). Fold and wrap the sample information sheet around the bottle, and put them both into a water-proof plastic bag. Keep the sample dark and cold (on ice or refrigerated) until it is delivered to ***Tent 26*** at Ag Expo. In some areas of the state MGSP groundwater technicians or MSU Extension staff will accept samples and transport them to Ag Expo. Contact them for more information, at your local Conservation District or MSU Extension office.



The results from your water sample will be strictly confidential. You will be mailed a copy of your results and information about what you should do if the concentration of nitrate is too high or if triazines are detected in the sample.

Please be sure to fill out the sample information sheet on the back side of this flyer as thoroughly as possible and bring it with your water sample to Ag Expo. **We need a complete mailing address to get your results back to you.** You can get more information from your local MGSP technician, at your county Extension Office, or by calling the MDA at (517) 373-6893.

This program is sponsored by the MDA, MSU Extension, and the Michigan Groundwater Stewardship Program. It is funded through the Michigan Groundwater and Freshwater Protection Act, the MDA, and the U.S. Environmental Protection Agency.

☞ *over for sample information*

MICHIGAN GROUNDWATER STEWARDHIP PROGRAM
DRINKING WATER WELL SCREENING
AG EXPO 2003
TENT 26

Sample Code Number ***(Please Leave Blank)***

Please complete this form and submit it with your well water sample.
Complete one form for each sample submitted
Please, write clearly!

Name ____

Sampling Address (where sample was taken)
Street ______________________
City/State/Zip ______________________
Phone ______________________
County ______________________

Mailing Address for Results (if different)
Street ______________________
City/State/Zip ______________________
Phone ______________________
County ______________________

Date Sampled: ______________________

Sampling Point: *If you are submitting more than one sample, it is very important to identify the different samples clearly (cottage well, mom's well, etc)*______________________

Well depth, feet (estimate if unknown) _______ Age of well, years: (estimate if unknown) ________

Well diameter (circle the correct figure, estimate if not known): 2" 4" 5" 6" Other________

Are there pregnant women or infants under the age of 6 months in your home? Y N

Do you use any treatment device, water softener, or carbon filter for your water? Y N

If yes, please describe ____

Well distance (ft.) from:
- Nearest farmed field ______________________
- Nearest septic system drain field ______________________
- Animal yard (feedlot, penned horses, cows, chickens, pigs)__________
- Chemical storage or mixing area ______________________

Please check the best description of your general soil texture:

______Very coarse/sand ____ Sandy loam ____ Silt loam ____ Loamy or sandy clay

______Heavy clay ______Organic/muck Other ______________________

Major land-use/crops within a half–mile of your well (row crop, pasture, orchard, forest, rural residential, orchard, commercial, industrial, etc)______________________

____

Have any triazines, such as atrazine, AAtrex, Princep, Bladex, Pramitol, Sencor, simazine, cyanazine, prometon, propazine, or metribuzin; been used on your property within the last three years?

Y N Unknown

robat Docume

EnviroGard Triazine Plate Kit User Instructions. Double-Click to open the document in Adobe Acrobat.